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NEBC MEETING NEWS

April 1998. Dr. John Beaman, the Club's Distinguished Speaker for 1998, was given a long introduction by former student, Dr. Garrett Crow. In 1983–84, Dr. Beaman held a Fulbright Fellowship, which enabled him to initiate his study of the flora of Borneo's Mount Kinabalu, which he has continued ever since, but particularly from 1994 to 1996 during two years as founding director of the Institute of Biodiversity and Environmental Conservation of University Malaysia Sarawak, and since then as an Honorary Research Fellow at The Royal Botanic Gardens, Kew, England.

John Beaman began by acknowledging that he could not feel too smug in being the Distinguished Speaker, given that it had been 44 years since his first and only other presentation to the Club. He then launched into his lecture entitled "The Systematics and Evolution of the Flora of Mt. Kinabalu (Borneo): An Example of Conservation Biology in Action." Via spectacular images, we were quickly taken to a lushly vegetated mountain with precipitous slopes and waterfalls located a few degrees north of the equator in northern Borneo, where Beaman, his son Reed (named for Dr. Reed Rollins), and about 40 other collaborators have been engaged in a number of projects aimed primarily at achieving a better understanding of the evolutionary and phytogeographic significance of the mountain and its flora. Part of Kinabalu's significance is that it is the highest mountain (c. 4100 m) between the Himalayas and the mountains of New Guinea. We were given a quick tour up the mountain through five elevationally defined zones: 1) lowlands with rattans (viny, spiny palms), some over 150 ft. long; 2) hill forests with the world's largest orchid, *Grammatophyllum speciosum,* growing epiphytically; 3) lower montane forest—the zone with the most species-rich elevation on the mountain at about 1500 m, and taxa including *Viburnum* and many orchids; 4) upper montane forest—a zone with three species of gymnosperms belonging to the Phyllocladaceae and Podocarpaceae. The celery pine *Phyllocladus hypophyllus* has false leaves, actually flattened stem tissue, anatomically. Isozyme studies of the genus *Leptospermum* from this elevation suggest that one of the species, now a dominant in an elfin forest community at 3000 m, has a post Pleistocene origin; 5) an open granitic summit with glacial scars from 9500 yrs. BP and interesting plants in its crevices and seeps. Interestingly, GIS studies relating floristic diversity to unit area revealed that species per 10 km^2 was actually greatest at 2500–3000 m, rather than at lower elevations.

Kinabalu is a batholith of granite formed in the Pliocene (c. 1–2 million years BP) under water, then uplifted in the Pleistocene through sedimentary formations. Because the mountain is young geologically and has a history of glaciation, Beaman and colleagues found it to be an ideal outdoor lab for studying examples of rapidly evolving plant groups. Ultramafic areas of serpentine at mid- and lower elevations have especially rich floras. Genetic studies of tree fern taxa on Kinabalu by Dave Conant, for instance, showed an endemic to the serpentine with likely derivation from a species in an adjacent geological formation. Studies of *Dendrochilum, Polyosma, Cyathea, Lithocarpus, Carex,* and *Rhododendron* are among those receiving the attention of collaborating systematists currently.

The flora has proven to be one of the most diverse in the world. There are many genera rich in species, including the figs with about 100 taxa. One ultramafic serpentine area of hardly more than 100 ha has over 300 species of orchids. One of Beaman's projects has involved the employment of local people in documenting the flora. This has been very successful and has significantly expanded the number of species, especially in certain groups like the palms, where extra money was paid per specimen collected. The botanical inventory has resulted in two books thus far. One covers the pteridophyte flora with 620 species, ⅓ more taxa than on the entire African continent; the other enumerates 711 orchid taxa. His most recent and still unpublished work is an enumeration of the gymnosperms and non-orchid monocotyledons. Using the Cyperaceae as an exemplar group he illustrated that the closest floristic affinities are with continental Asia, but that other taxa are of Malesian and Australian affinity. The mountain has many neo-endemics, suggesting that a very rapid evolutionary process is happening on the mountain. Among the most interesting endemics are some of the pitcher plants, *Nepenthes,* with several species restricted to serpentine. He also showed a common lowland species with vestigial pitcher lids. The endemic *N. rajah* has the largest pitchers in the genus, and has even been known to trap mice.

Macrophotography through the base of the giant flowers of

Rafflesia pricei, in the genus with the largest known flowers, illustrated what Beaman and his students have learned about its pollination ecology. The flowers are unisexual and pollinated by carrion flies, which are guided by the odor and appearance of rotting meat to anthers on male flowers, where they are precisely positioned by internal bristly ridges to pick up a load of pollen on their backs. When they go to a female flower the pollen load is rubbed off on the broad stigmatic surface of the female flowers. The Beaman team has hypothesized that the flies are deceived into visiting *Rafflesia* flowers as potential brood places. They receive no reward for their efforts, however. A slide was used to illustrate one site of this important study area that has since been lost to slash and burn practices.

Unfortunately, Kinabalu, like so many other tropical areas, is under siege. Slash and burn agriculture, copper and gold mining, and illegal logging within park boundaries have had major impacts. Some areas once species-rich have been cut and burned, and Beaman believes they will never recover lost species and ecosystem characteristics. Much responsibility rests on the shoulders of Malaysian botanists and naturalists who are studying and attempting to educate others about their rich and endangered flora. In response to questions after the talk, it was pointed out that the biologists and park managers are working very hard to preserve their precious natural resources.

For additional reading about Mount Kinabalu, Dr. Beaman recommends a book on the natural history of the mountain published in 1996, entitled *Kinabalu—Summit of Borneo,* edited by K. M. Wong and A. Phillipps and published by the Sabah Society.

—PAUL SOMERS, Recording Secretary.

May 1998 Field Trip. Fifteen Club members and families enjoyed an unseasonably warm hike up Mt. Major on Alton Bay, NH, on May 1st to search for early spring blooms. The trail led up through dry hemlock/beech/oak/red maple woods with *Acer pensylvanicum, Viburnum alnifolium, Uvularia sessilifolia, Viola fimbriatula, Diervilla lonicera, Prunus pensylvanica, Vaccinium angustifolium* and several tantalizing carices in bloom. The higher rocky outcrops below the 1784-foot summit yielded *Epigaea repens, Amelanchier bartramiana*, and *Arctostaphylos uva-ursi* in bloom, as well as *Clintonia borealis* in bud and spectacular views of Lake Winnipesaukee. The group also observed the remarkable and extensive tree damage from the winter ice storms.

—LISA A. STANDLEY

May 1998. Dr. Garrett Crow from the University of New Hampshire spoke on the topic "Biodiversity of Aquatic Plants in Costa Rica and Bolivia: Is New England Really the Amazonia of Aquatic Diversity?" Utilizing floristic data from his aquatic plant research in Costa Rica, which began in 1984 with a sabbatical at the Universidad Nacional de Costa Rica, and recent trips to Bolivia to assist doctoral student, Nur Ritter, Garrett attempted to convince us that northern temperate aquatic ecosystems in formerly glaciated New England and Michigan were often equal to or more species-rich than those of comparable size and general ecological character at his tropical sites. This, of course, is contrary to the general pattern where vascular plant floras in tropical areas are dramatically larger than their temperate counterparts of comparable size. Demonstrating this general trend, he stated that Costa Rica has a very rich flora comprised of 10–12,000 vascular plant species, whereas the Carolinas, which are over four times larger, have only 3360 species. His inventories of wetlands in Costa Rica and Bolivia often showed the opposite pattern, with fewer or comparable numbers to those found at New England sites studied by himself and others.

To better understand this apparent reversal of the normal phenomenon, he looked at the problem from two approaches: 1) by comparing species richness latitudinally on a similar habitat basis, and 2) by comparing richness in various taxonomic groups among regional aquatic plant floras. Many examples of the habitat basis comparisons were given. The individual floras of two ponds in Puntarenas, C.R., were comparable in number, about 20 species, to that of Turtle Pond in Lee, N.H., but the flora of Costa Rica's Lago Hule was only 25 species compared with the 125 species reported by Hellquist for New Hampshire's Lake Ossipee. Also, peatlands of New Hampshire and Michigan, when compared to páramo and sphagnum bogs of Costa Rica's Cordillera de Talamanca, came up much higher in species' numbers. In defense of the páramos, however, he noted such interesting species as *Puya dasylirioides,* a spectacular bromeliad, and *Drimys granadensis* in the Winteraceae, a primitive angiosperm family. Applying his second approach, he compared numbers of species in aquatic plant families in three regions: northeastern North America, southeastern United States, and Central America. The total number of species (145) was slightly higher in the northeastern U.S. than in the southeastern U.S. (122 spp.) or Central America (120 spp.). Comparing individual families across the three regions, he showed that certain families, e.g., Eriocaulaceae and Mayacaceae, had the most taxa in Central America, but many other groups, such as the Cyperaceae and Haloragaceae were highest in the northeastern U.S. and poorly represented in Central America.

Garrett then took us south to Bolivia where he and Nur Ritter have been further examining aquatic plant diversity. Bolivia is approximately two times the size of Central America. It is much less explored than Central America botanically (1/10th the number of collections), but is estimated to have a flora of 18,000 vascular plant species. Starting in the Cochabamba Valley, our northern botanists headed off to explore wetlands ranging from a sphagnum bog at 2920 m elevation with 21 species to some tropical lowland sites in the upper Amazon Basin where some of the highest species counts (65–84 species) were obtained. While many interesting and beautiful species were observed, the species richness was generally equal to or less than in the northeastern U.S.

It is Garrett's hope that his investigations will help conservationists set priorities regarding protection of wetland habitats. In Costa Rica's Palo Verde/Rio Tempisque, for instance, where 97 species occur, this should be valued as an area of high tropical diversity, even though lower than that found in many temperate swamplands. He also hopes that these studies will further the recognition of northern temperate wetlands of New England as the "Amazonia" of aquatic diversity. When asked afterwards why he thought diversity was higher in the northeastern U.S., he speculated that there appears to be a relationship between high diversity and areas glaciated during the Pleistocene. As support for this he noted the relatively low diversity in unglaciated areas of Siberia.

June 1998. Dr. Aaron M. Ellison, Fisher Associate Professor of Environmental Studies in the Department of Biological Sciences at Mount Holyoke College, addressed the topic "Direct Interactions Between Northern Pitcher-plants (*Sarracenia purpurea*) and

Their Associated Animal Communities." His talk dealt with research ideas being explored by himself, students, and Nicholas J. Gotelli, a collaborator at the University of Vermont.

The Sarraceniaceae, or pitcher-plant family, occurs only in the western hemisphere. Members of the family in the genera *Sarracenia, Darlingtonia,* and *Heliamphora* are characterized by pitcher-like leaves that trap water and in it a variety of organisms. How are these pitchers formed? What environmental and physiological factors influence the formation of pitchers? These are among the questions for which the researchers are seeking answers. Using a two hectare sphagnum bog mat at Hawley Bog in Franklin County, Massachusetts, as an outdoor research area and with more controlled environments provided by greenhouses, the researchers will attempt to quantify energy and nutrient inputs and outputs from purple pitcher-plants, *S. purpurea,* in order to better understand the factors influencing pitcher formation. These results may be applicable to the eastern hemisphere pitcher-plant families Nepenthaceae and Cephalotaceae.

Ellison presented several perspectives on pitcher-plant ecology. From an insect's perspective, pitchers are distributed in a patchy fashion and are of various quality for meeting their needs. The insects themselves play an important role in controlling the quality of these patches. A typical zoologist's view of pitcher-plants, he said, is to treat them as vaselike organisms containing an aquatic ecosystem. Their studies thus far have involved examination of the relationships among protozoans, mosquitoes, flies, rotifers, midges, mites, yeast, and bacteria. In a given year, pitcher leaves are colonized by three basic communities of organisms: one dominated by rotifers and mites, one dominated by midge and mosquito larvae, and one consisting only of larvae of a sarcophagid fly. Rotifers such as *Habrotrocha rosa,* via their excretion rates, may be capable of supplying all the pitcher-plants' needs for nitrates, ammonia, and phosphate. The quality of the pitcher-plant patches varies, he said, depending in large part on what the inhabitants do. The botanical view focuses mainly on the "living plant" and takes into consideration the role of photosynthesis, growth rates, and how these factors and nutrients influence pitcher leaf formation and flower production. Is there any relationship between pitcher nutrients and growth? One research question being asked is whether or not adding nutrients to the pitchers will influence leaf production. In the oligotrophic bog environment, it has been assumed that few nutrients are taken up by the roots even though they may be well developed. Ellison's goal is to get the complete "pitcher," relating both botanical and zoological aspects to how pitcher plants function.

Part of getting the complete "pitcher" has involved monitoring the Hawley Bog population. Monitoring in 1996 and 1997 has shown there is considerable year to year variation in the percent that produce flowers (ca. 10% in '96 vs ca. 50% in '97) and in the number of pitcher vs. flat leaves (called phyllodia) produced. Interestingly, the phyllodia, which are also referred to as winter leaves, sometimes produce rudimentary pitchers at their apices. What factors determine flower or pitcher production? Why should plants produce pitchers at all, Ellison has asked? Since flat leaves intercept more light, they may be more effective at delivering the benefits of photosynthesis. Why be carnivorous? Since bogs are high light but low nutrient environments, a role in providing key nutrients is generally regarded as a reason for carnivory. By carefully monitoring and modeling the nutrient conditions in the bog habitat, in the pitcher-plants, and in the pitchers with their inquiline assemblages, Ellison and company hope to better understand the complexity of these interrelationships and what triggers the pathway to carnivory.

—PAUL SOMERS, Recording Secretary.